

Facility Name Big River Mine Tailings

Location Near Desloge, Missouri

EPA Region Region VII

Person(s) in charge of the facility Marvin Hudwalker, Hudwalkers &

Associates Eng

C G Mattsson, St Joe Minerals

Bryant AuBuchon, Landfill Mgr

Name of Reviewer Bob Overfelt

Date May 20, 1988

General description of the facility

(For example landfill, surface impoundment, pile, container, types of hazardous substances, location of the facility, contamination route of major concern, types of information needed for rating; agency action, etc)

The Big River Mine Tailings site is approximately 600 acres of Pb,
Cd, and Zn rich mine tailings that are uncontrolled The site is
bordered on three sides by the Big River and is located in St Francois
County near Desloge, Missouri The tailings are sand and silt size,
unconsolidated and very permeable There is also an active landfill on
60 acres of the site

Scores $S_M = 58.4$ ($S_{gw} = 83.8$ $S_{sw} = 10.9$ $S_a = 55.4$)

$S_{FE} =$ Not evaluated

$S_{DC} =$ Not evaluated

FIGURE 1
HRS COVER SHEET

40108751



SUPERFUND RECORDS

Ground Water Route Work Sheet						
Rating Factor	Assigned Value (Circle One)		Multi- plier	Score	Max Score	Ref (Section)
1 Observed Release	0	45	1	0	45	3.1
If observed release is given a score of 45 proceed to line 4 If observed release is given a score of 0 proceed to line 2						
2 Route Characteristics						3.2
Depth to Aquifer of Concern	0	1 2 3	2	6	6	
Net Precipitation	0	1 2 3	1	2	3	
Permeability of the Unsaturated Zone	0	1 2 3	1	3	3	
Physical State	0	1 2 3	1	3	3	
Total Route Characteristics Score				14	15	
3 Containment	0	1 2 3	1	3	3	3.3
4 Waste Characteristics						3.4
Toxicity/Persistence	0	3 6 9 12 15 18	1	18	18	
Hazardous Waste Quantity	0	1 2 3 4 5 6 7 8	1	8	8	
Total Waste Characteristics Score				26	26	
5 Targets						3.5
Ground Water Use	0	1 2 3	3	9	9	
Distance to Nearest Well/Population Served	0	4 6 8 10	1	35	40	
	12	16 18 20				
	24	30 32 35 40				
Total Targets Score				44	49	
6 If line 1 is 45 multiply 1 x 4 x 5 If line 1 is 0 multiply 2 x 3 x 4 x 5				48,048	57,330	
7 Divide line 6 by 57,330 and multiply by 100				S _{gw} = 83.8		

FIGURE 2
GROUND WATER ROUTE WORK SHEET

Surface Water Route Work Sheet						
Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max Score	Ref (Section)	
1 Observed Release	0 <u>45</u>	1	45	45	4.1	
If observed release is given a value of 45 proceed to line 4 If observed release is given a value of 0 proceed to line 2						
2 Route Characteristics					4.2	
Facility Slope and Intervening Terrain	0 1 2 3	1		3		
1 yr 24 hr Rainfall	0 1 2 3	1		3		
Distance to Nearest Surface Water	0 1 2 3	2		6		
Physical State	0 1 2 3	1		3		
Total Route Characteristics Score				15		
3 Containment	0 1 2 3	1		3	4.3	
4 Waste Characteristics					4.4	
Toxicity/Persistence	0 3 6 9 12 15 <u>18</u>	1	18	18		
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 <u>8</u>	1	8	8		
Total Waste Characteristics Score			26	26		
5 Targets					4.5	
Surface Water Use	0 1 <u>2</u> 3	3	6	9		
Distance to a Sensitive Environment	<u>0</u> 1 2 3	2	0	6		
Population Served/Distance to Water Intake Downstream	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	0	40		
Total Targets Score			6	55		
6 Line 1 is 45 multiply 1 x 4 x 5 Line 1 is 0 multiply 2 x 3 x 4 x 5			7,020	64,350		
7 Divide line 6 by 64,350 and multiply by 100			S _{SW} = 10.9			

FIGURE 7
SURFACE WATER ROUTE WORK SHEET

Air Route Work Sheet						
Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max Score	Ref Section	
1 Observed Release	0 (45)	1	45	45	5.1	
Date and Location January 25, 1988, and May 16, 1988 Big River Mine Tailings Site						
Sampling Protocol Tailings known to be rich in Pb, Cd, and Zn and photo documentation conducted to show release						
If line 1 is 0 the $S_a = 0$ Enter on line 5 If line 1 is 45 then proceed to line 2						
2 Base Catecholic Reactivity and Incompatibility	0 (1) 2 3	1	1	3	2	
Toxicity	0 1 2 (3)	3	9	9		
Mass of Waste Quantity	0 1 2 3 4 5 6 7 (8)	1	8	8		
Total Catecholic Score			18	20		
Base Catecholic Reactivity and Incompatibility	0 (2) 1 2 3	1	21	21	2	
Toxicity	0 1	2	0	2		
Land Use	0 1 2 (3)	1	3	3		
Total Base Catecholic Score			24	24		
Total Score = 1 x 1 x 1			19440			
Divide by 12 by 3.0 and by 100			$S_a =$	55.4		

FIGURE 9
AIR ROUTE WORK SHEET

NOT EVALUATED

Fire and Explosion Work Sheet													
Rating Factor	Assigned Value (Circle One)				Multi- plier	Score	Max Score	Ref (Section)					
1 Containment	1	3			1		3	7 1					
2 Waste Characteristics								7 2					
Direct Evidence	0	3			1		3						
Ignitability	0	1	2	3	1		3						
Reactivity	0	1	2	3	1		3						
Incompatibility	0	1	2	3	1		3						
Hazardous Waste Quantity	0	1	2	3	4	5	6	7	8	1	8		
Total Waste Characteristics Score							20						
3 Targets								7 3					
Distance to Nearest Population	0	1	2	3	4	5	1	5					
Distance to Nearest Building	0	1	2	3			1	3					
Distance to Sensitive Environment	0	1	2	3			1	3					
Land Use	0	1	2	3			1	3					
Population Within 2 Mile Radius	0	1	2	3	4	5	1	5					
Buildings Within 2 Mile Radius	0	1	2	3	4	5	1	5					
Total Targets Score							24						
4 Multiply 1 x 2 x 3							1 440						
5 Divide line 4 by 1 440 and multiply by 100						SFE =							

FIGURE 11
FIRE AND EXPLOSION WORK SHEET

Not Evaluated

Direct Contact Work Sheet						
Rating Factor	Assigned Value (Circle One)		Multi- plier	Score	Max Score	Ref (Section)
<input type="checkbox"/> 1 Observed Incident	0	45	1		45	8 1
If line <input type="checkbox"/> 1 is 45 proceed to line <input type="checkbox"/> 4 If line <input type="checkbox"/> 1 is 0 proceed to line <input type="checkbox"/> 2						
<input type="checkbox"/> 2 Accessibility	0	1 2 3	1		3	8 2
<input type="checkbox"/> 3 Containment	0	15	1		15	8 3
<input type="checkbox"/> 4 Waste Characteristics Toxicity	0	1 2 3	5		15	8 4
<input type="checkbox"/> 5 Targets						8 5
Population Within a 1 Mile Radius	0	1 2 3 4 5	4		20	
Distance to a Critical Habitat	0	1 2 3	4		12	
Total Targets Score					32	
<input type="checkbox"/> E If line <input type="checkbox"/> 1 is 45 multiply <input type="checkbox"/> 1 x <input type="checkbox"/> 4 x <input type="checkbox"/> 5 If line <input type="checkbox"/> 1 is 0 multiply <input type="checkbox"/> 2 x <input type="checkbox"/> 3 x <input type="checkbox"/> 4 x <input type="checkbox"/> 5					2 50%	
<input type="checkbox"/> Divide line <input type="checkbox"/> E by 160 and multiply by 100				SDC =		

FIGURE 12
DIRECT CONTACT WORK SHEET

	s	s ²
Groundwater Route Score (S _{gw})	83 8	7,022 4
Surface Water Route Score (S _{sw})	10 9	118 8
Air Route Score (S _a)	55 4	3,069 2
$S_{gw}^2 + S_{sw}^2 + S_a^2$		10,210 4
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		101 1
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		58 4

FIGURE 10
WORKSHEET FOR COMPUTING S_M

FIT QUALITY ASSURANCE TEAM

DOCUMENTATION RECORDS
FOR
HAZARD RANKING SYSTEM

INSTRUCTIONS As briefly as possible summarize the information you used to assign the score for each factor (e g , "Waste quantity = 4,230 drums plus 800 cubic yards of sludges") The source of information should be provided for each entry and should be a bibliographic-type reference Include the location of the document

FACILITY NAME Big River Mine Tailings

LOCATION Desloge, Missouri

DATE SCORED May 20, 1988

PERSON SCORING Bob Overfelt

PRIMARY SOURCE(S) OF INFORMATION (e g , EPA region, state, FIT, etc)

Research reports prepared by the National Fisheries Research Laboratory in Columbia, MO, the University of Missouri - Rolla, the University of Missouri - Columbia

Photo documentation during site reconnaissance conducted by EPA/FIT

FACTORS NOT SCORED DUE TO INSUFFICIENT INFORMATION

Fire and Explosion
Direct Contact

COMMENTS OR QUALIFICATIONS

GROUND WATER ROUTE

1 OBSERVED RELEASE

Contaminants detected (5 maximum)

No observed release cited to date

Rationale for attributing the contaminants to the facility

Score = 0

* * *

2 ROUTE CHARACTERISTICS

Depth to Aquifer of Concern

Name/description of aquifer(s) of concern (Ref 1, Ref 2, Ref 32)

There are two aquifers underlying a 0-100' (Ref 21, 24) layer of mine tailings. In descending order are the Bonneterre and the Lamotte Formations. The Bonneterre is a light-gray to dark-brown dolomite that is fine to medium grained, glauconitic in places. It contains thin discontinuous shale beds and contains significant lead deposits in the form of galena (PbS). The Lamotte is a sandstone conglomerate, quartzose, arkosic, and contains interbedded red-brown shale. The tailings rest directly on the Bonneterre Formation (Ref 21). No aquitards exist between the two formations of concern.

Depth(s) from the ground surface to the highest seasonal level of the saturated zone [water table(s)] of the aquifer of concern

The water table was encountered at depths ranging from 13.5' to 34' below the surface of the tailings pile. These water levels lie within the tailings (Ref 21). Therefore, the minimal distance of 0 feet is assigned.

Score = 6

Depth from the ground surface to the lowest point of waste disposal/storage

The tailings pile ranges from 0-100 in thickness (Ref 3, Page 1a). The water table lies in the tailings (Ref 21). Therefore, the lowest point of waste disposal from the ground surface is 0 feet.

Net Precipitation

Mean annual or seasonal precipitation (list months for seasonal)

Mean annual precipitation is 42.86 inches (Ref 4, Page 48)

Mean annual lake or seasonal evaporation (list months for seasonal)

Mean annual lake evaporation is 37 inches (Ref 4, Page 63)

Net precipitation (subtract the above figures)

$42.86 - 37 = 5.86$ inches

Score = 2

Permeability of Unsaturated Zone

Soil type in unsaturated zone

The soils are formed in crushed dolomitic material (tailings) from lead mining. The underlying material is light gray loamy fine sand, stratified by lenses of light brownish gray silt loam (about 10% mass) (Ref 5, Sheet Number 13, and Page 40)

Permeability associated with soil type

Permeability is rapid, most precipitation is absorbed into the surface. Available water capacity is low (Ref 5, Page 40). Assigned value is 3 (Ref 18)

Score = 3

Physical State

Physical state of substances at time of disposal (or at present time for generated gases)

At the time of disposal the material was deposited as a tailings slurry (liquid). It is now a fine powder-type material (Ref 3, Page 1)

Score = 3

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3 CONTAINMENT

Containment

Method(s) of waste or leachate containment evaluated

The tailings pile is uncovered and unstable (Ref 3, Page 2a) The sanitary landfill on a portion of the site, has no liner (Ref 31)

Method with highest score

Tailings pile = 3

Score = 3

4 WASTE CHARACTERISTICS

Toxicity and Persistence

Compound(s) evaluated	(Ref 12, pp 28, 29, and 30, Ref 34)
	<u>Toxicity</u> <u>Persistence</u>
Lead (Pb)	3 3 (Ref 7, Page 1688-1689, Ref 18)
Zinc (Zn)	--- 3 (Ref 7, Page 2751, Ref 18)
Cadmium (Cd)	3 3 (Ref 7, Page 610, Ref 18)

Compound with highest score

Lead and cadmium (Ref 7)

Score = 18

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility, excluding those with a containment score of 0 (Give a reasonable estimate even if quantity is above maximum)

This is a massive pile of mine tailings that covers more than 600 acres and is from 0-100 feet deep (Ref 3, Page 1a, Ref 16, Ref 25)

Basis of estimating and/or computing waste quantity

Site consists of 600 acres of mine tailings containing lead, cadmium and zinc and are 0-100 feet in thickness (Ref 3, Page 1a) On-site monitoring well logs show the average thickness of the tailings to be 48 feet (Ref 21)

$$600 \text{ acres} \times \frac{43,560 \text{ ft}^2}{\text{acre}} \times 48 \text{ ft thick} = 1.25 \times 10^9 \text{ ft}^3 \times \frac{1 \text{ yd}^3}{27 \text{ ft}^3} = 46,464,000 \text{ yd}^3$$

Score = 8

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SURFACE WATER ROUTE

1 OBSERVED RELEASE (Ref 3, pp 1, 1a, Ref 9, pp 1, 20, 21, 28, 29, 67-70, 110, 117, 130, 134, Ref 13, pp 4-2, 4-3, 4-4)

Contaminants detected in surface water at the facility or downhill from it (5 maximum)

Lead (Pb) has been detected at slightly elevated levels at the site and four miles down river. Also the sediments on the bottom of the river have been changed drastically in a physical and chemical manner. Collapse of mine tailings has been documented. Elevated levels of lead have been detected in fish downgradient of the site.

	<u>Water Samples (Dissolved Pb)</u>	<u>Sediment Samples (Pb)</u>
Irondale (Bkg)	0.005 mg/l	49.6 ug/g
Desloge	0.012 mg/l	2,215.0 ug/g
Wash State Park	0.021 mg/l	1,843.4 ug/g
Browns Ford	0.026 mg/l	1,438.3 ug/g

Rationale for attributing the contaminants to the facility

Tests of the Big River bottom sediment have proven that a major release (approximately 50,000 yd³) of Pb, Zn, and Cd rich tailings into the river in 1977 have elevated the contents of Pb in both the surface water and bottom sediment above background levels. Cd and Zn are also elevated in the bottom sediment (Ref 3, pp 1, 1a, Ref 9).

Score = 45

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2 ROUTE CHARACTERISTICS NA

Facility Slope and Intervening Terrain

Average slope of facility in percent

Name/description of nearest downslope surface water

Average slope of terrain between facility and above-cited surface water body in percent

Is the facility located either totally or partially in surface water?

Is the facility completely surrounded by areas of higher elevation?

1-Year 24-Hour Rainfall in Inches

Distance to Nearest Downslope Surface Water

Physical State of Waste

3 CONTAINMENT

Containment

Method(s) of waste or leachate containment evaluated

Method with highest score

4 WASTE CHARACTERISTICS

Toxicity and Persistence

See Ground Water Route

Score = 18

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility, excluding those with a containment score of 0 (Give a reasonable estimate even if quantity is above maximum)

See Ground Water Route

Basis of estimating and/or computing waste quantity

See Ground Water Route

Score = 8

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5 TARGETS

Surface Water Use

Use(s) of surface water within 3 miles downstream of the hazardous substance

Recreational uses include fishing, boating, and swimming. Other uses include livestock watering and wildlife watering (Ref 10). It is also known that the bottom feeding fish at the Desloge site and for miles downstream have elevated levels of Pb in their edible tissue. Samples consistently exceed the World Health Organization (WHO) dietary limit of 0.3 ug/g (Ref 9, Pages 1 and 110).

Score = 6

Is there tidal influence?

No

Distance to a Sensitive Environment

Distance to 5-acre (minimum) coastal wetland, if 2 miles or less

None (Ref 16)

Distance to 5-acre (minimum) fresh-water wetland, if 1 mile or less

None known (Ref 16 and 17)

Distance to critical habitat of an endangered species or national wildlife refuge, if 1 mile or less

None (Ref 16 and 17)

Score = 0

Population Served by Surface Water

Location(s) of water-supply intake(s) within 3 miles (free-flowing bodies) or 1 mile (static water bodies) downstream of the hazardous substance and population served by each intake

There are no intakes within 3 stream miles of site (Ref 10)

Score = 0

Computation of land area irrigated by above-cited intake(s) and conversion to population (1 5 people per acre)

There are no intakes within 3 stream miles of the site (Ref 10)

Score = 0

Total population served

0

Score = 0

Name/description of nearest of above water bodies

The Big River is the nearest perennial water body It borders the site on the west, north, and east sides (Ref 16)

Distance to above-cited intakes, measured in stream miles

The nearest intake is greater than 3 miles downstream from the site (Ref 10)

AIR ROUTE

1 OBSERVED RELEASE

Contaminants detected

The mine tailings at the Desloge tailing pile have been sampled and are known to be rich in Pb, Cd, and Zn. Mean concentrations were Pb 2,077 ug/g, Cd 26 ug/g, and Zn 1,226 ug/g. A control soil sample was taken for the same study which contained much less Pb than the tailings. The control sample was taken 1 mile north of Farmington, Missouri approximately 8 miles from the site (Ref 12, Pages 28-30, 55, 73-75).

Date and location of detection of contaminants

During a reconnaissance of the site on January 25, 1988, photo documentation was conducted. It is evident from the photographs taken and from observations that a significant amount of tailings were airborne and that a plume existed for at least 1 mile to the southeast of the site (Ref 13, Appendix C). May 1988 sampling of the mine tailings has confirmed the presence of Pb, Cd, and Zn at concentrations ranging from 880 mg/kg to 1,400 mg/kg of Pb; 8.4 mg/kg to 19 mg/kg of cadmium, and 370 mg/kg to 1,100 mg/kg of zinc (Ref 33, 34, and 35). This confirms the presence of these contaminants in the airborne plume.

Methods used to detect the contaminants

Tailings samples were taken prior to and subsequent to the photo-documentation of an airborne plume.

Rationale for attributing the contaminants to the site

It has been determined by laboratory analyses that the tailings on-site contain substantial amounts of Pb, Cd, and Zn. It has also been determined by photo documentation that these tailings become easily airborne (Ref 12, Page 29 and 30, Ref 13, Appendix C, Ref 33, Ref 34; Ref 35).

Score = 45
* * *

2 WASTE CHARACTERISTICS

Reactivity and Incompatibility

Most reactive compound

Cd, Pb, and Zn present a moderate fire hazard when in the dust form and exposed to flame (Ref 7, Pages 610, 1,688, 1,689, 2,751).

Score = 1

Most incompatible pair of compounds

Zn and Cd are stated to be incompatible but do not pose an immediate hazard (Ref 7, Page 2,751, Ref 18).

Score = 1

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility

Basis of estimating and/or computing waste quantity

* * *

3 TARGETS

Distance to Nearest Population

Distance to Nearest Building

Distance to Sensitive Environment

Distance to wetlands

Distance to critical habitat

Land Use

Distance to commercial/industrial area, if 1 mile or less

Distance to national or state park, forest, or wildlife reserve, if 2 miles or less

Distance to residential area, if 2 miles or less

Distance to agricultural land in production within past 5 years, if 1 mile or less

Distance to prime agricultural land in production within past 5 years, if 2 miles or less

Is a historic or landmark site (National Register or Historic Places and National Natural Landmarks) within the view of the site?

Population Within 2-Mile Radius

Buildings Within 2-Mile Radius

5 TARGETS

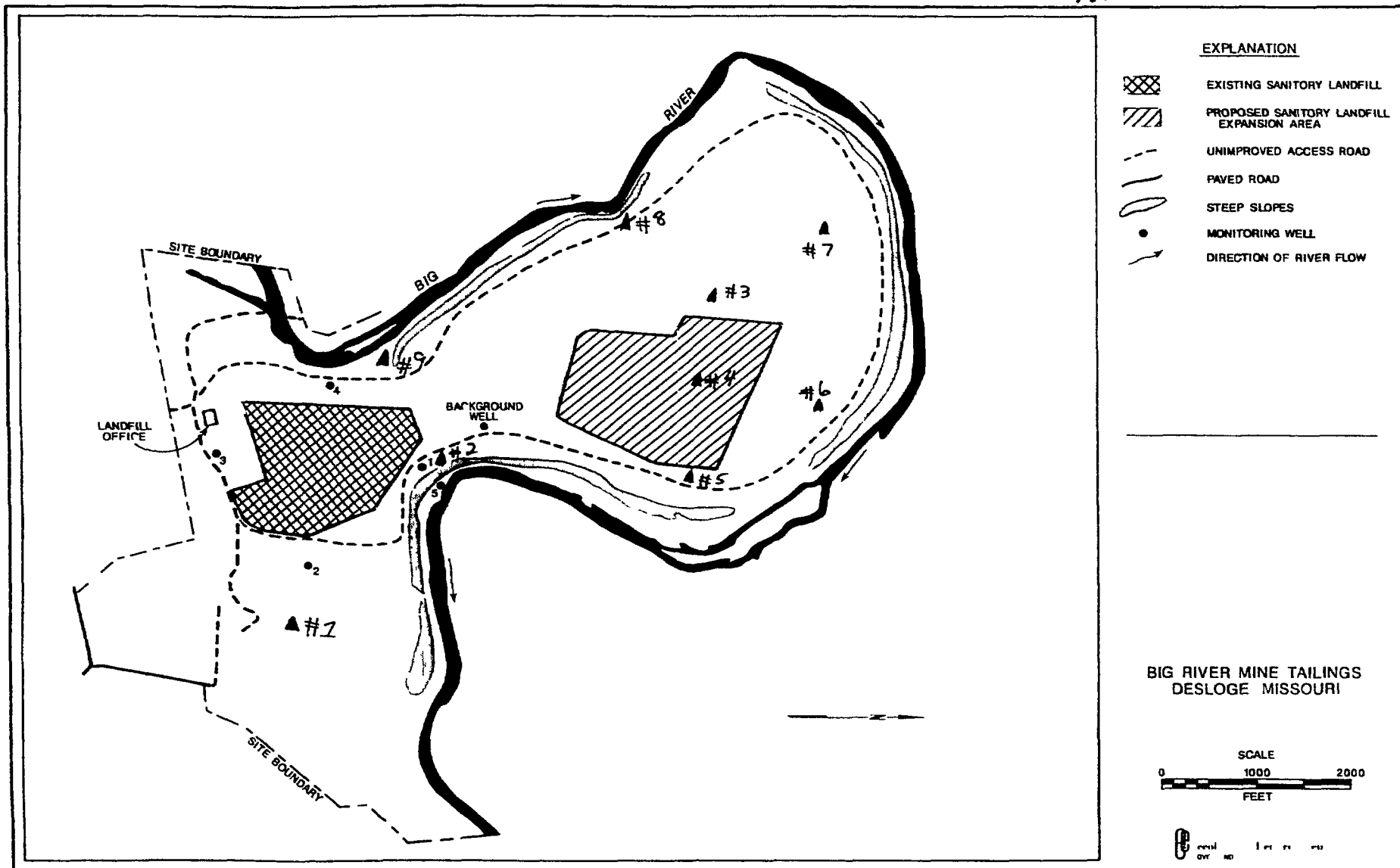
Population within one-mile radius

Distance to critical habitat (of endangered species)

HRS DOCUMENT LOG SHEET		SITE NAME <u>Big River Mine Tailing</u>	
		CITY <u>Desloge</u>	STATE <u>Missouri</u>
		IDENTIFICATION NUMBER _____	
REFERENCE NUMBER	DESCRIPTION OF REFERENCE		
1	The Stratigraphic Succession in Missouri, Division of Geological Survey and Water Resources, Wallace B Howe, September 1961		
2	Miller, Don, March 1, 1988, Personal Communication, Missouri Geologic Survey, Geologist, with Bob Overfelt, E & E/FIT		
3	Emergency Action Plan for Lead Mine Tailings, Desloge, Missouri, 1981 MDNR		
4	Climatic Atlas of the United States, 1979, U S Department of Commerce		
5	Soil Survey of St Francois County, Missouri, August 1981, United States Department of Agriculture Soil Conservation Service		
6	Not Used		
7	Sax, N Irving, 1984 Dangerous Properties of Industrial Materials 6th Ed		
8	Johnson, Dennis, March 1, 1988, Personal Communication Asst Manager Flat River Water District, with Bob Overfelt, E & E/FIT		

[illegible]

REF. 33



Site Map

APPENDIX 10

NUMBER OF OBSERVATIONS FOR t-TEST OF DIFFERENCE BETWEEN TWO MEANS

Reprinted from Table 1 of David G. V. *The Design and Analysis of
of Experiments* by David G. V. Oliver and Boyd Edinburgh 1956. By per-
mission of the author and publisher.
The entries in this table show the number of observations n in each of the
two groups of the difference between two means in order to control the
probability of the error of the first kind at α and β respectively by
Table 1 of David G. V. *The Design and Analysis of Experiments* show the number of ob-
servations n in each of the two groups.

Sig. of S.E.T. Test David G. V. Table 1	1 / 1 / Test																			
	0.01					0.05					0.10					0.20				
	$\alpha = 0.005$					$\alpha = 0.01$					$\alpha = 0.05$					$\alpha = 0.10$				
	0.01	0.05	0.1	0.2	0.5	0.01	0.05	0.1	0.2	0.5	0.01	0.05	0.1	0.2	0.5	0.01	0.05	0.1	0.2	0.5
0.0																				0.0
0.10																				0.10
0.1																				0.15
0.20																				0.20
0.25																				0.25
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1.5																				1.5
1.6																				1.6
1.7																				1.7
1.8																				1.8
1.9																				1.9
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